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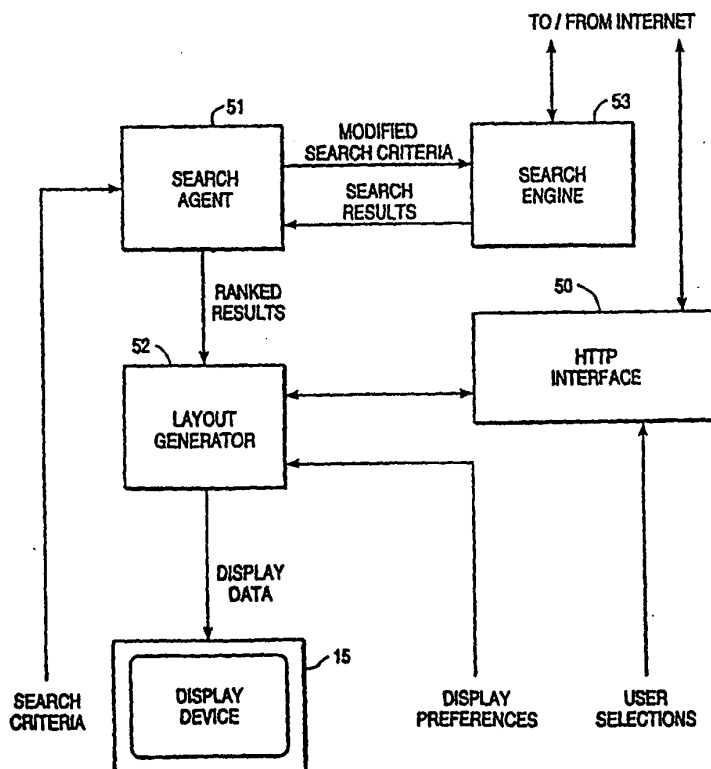
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(54) Title: METHOD AND APPARATUS FOR GRAPHICALLY REPRESENTING PORTIONS OF THE WORLD WIDE WEB

(57) Abstract

A technique is provided for displaying a map of a portion of the World Wide Web. A number of Web documents are retrieved by a client computer system executing a search engine. Web documents are then represented on a display device as objects and the relevance of a Web documents to the search criteria is indicated by the apparent distance of the corresponding object to the user. Hypertext links between Web documents are represented as arrows between the objects. Additional information relating to Web sites, such as the popularity of a Web site, the length of a Web document, and the number of hypertext links in a Web document, are represented to the user visually using visual attributes of objects, such as color, shape and texture.



-1-

Method and Apparatus for Graphically Representing Portions
of the World Wide Web

FIELD OF THE INVENTION

The present invention pertains to the field of computer systems. More particularly, the present invention relates to graphically representing hypertext documents distributed over a network.

BACKGROUND OF THE INVENTION

The World Wide Web ("the Web") is a collection of formatted, hypertext-based documents (often referred to as "Web pages") distributed among numerous computers around the world which are logically connected by the Internet. The Web is a valuable resource for information relating to numerous subjects, including science, technology, business, entertainment, and travel, to name just a few. Improvements in Web-related technology, such as Web browsers (software applications which provide graphical user interfaces to the Web), have made the Web accessible to a large segment of the population. Despite these improvements, however, modern Web technology still has numerous shortcomings.

Web documents commonly reference other Web documents using hypertext links. A hypertext link enables a computer user to select a word, phrase or an image (a "hypertext anchor") to signal the computer retrieve a referenced Web document located on a remote server. With Web technology of the prior art, the user generally receives no explicit information regarding the relationships between Web documents. Thus, the user generally relies upon his own "mental map" of a given portion of the Web, which he slowly forms throughout the process of navigating the Web. However, this mental map is often vague, incomplete, and inaccurate. It would be useful when browsing the Web, therefore, for a user to have a clearer understanding of the logical relationships between Web documents, so that the user can more easily navigate portions of the Web.

A common way for a computer user to determine the location of information on the Web is to search the Web using software known as a search engine. A search engine accepts search criteria entered by the user, searches the Web based on the criteria, and generally provides the user with a listing of Web documents which, at least to some extent, match the criteria. Examples of well-

-3-

hypertext-based documents is represented using a visual attribute of an object that corresponds to that hypertext-based document.

Other features of the present invention will be apparent from the accompanying drawings and from the detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1 illustrates a network configuration including a client computer system and a number of server computer systems.

Figure 2 is a block diagram of a client computer system.

Figure 3 illustrates a display showing objects representing a number of Web documents.

Figure 4 illustrates a display showing objects representing a number of Web documents, with arrows representing hypertext links between Web documents.

Figure 5 illustrates a display showing a representation of a Web document and its hypertext links to other Web documents.

Figure 6 is a block diagram of software components used to implement the present invention.

Figure 7 is a flow diagram illustrating an overall routine for generating a visual map of a portion of the Web based on the results of a search.

Figure 8 is a flow diagram illustrating a particular routine for generating a three-dimensional map of a portion of the Web based on ranked search results.

DETAILED DESCRIPTION

A method and apparatus for graphically representing a portion of the World Wide Web ("the Web") are described. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be evident, however, to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to facilitate description of the present invention.

-5-

connection to the Internet backbone 3 is provided to the client 1 by an Internet Service Provider (ISP) 4. In one embodiment, the servers 2 are Web servers which store Web documents and provide Web documents to the client 1 in response to requests from the client 1.

Figure 2 illustrates the hardware architecture of the client 1 according to one embodiment. It will be recognized that any or all of the servers 2 may also have the architecture illustrated in Figure 2 or a similar architecture. The client 1 includes a central processing unit (CPU) 10, random-access memory (RAM) 11, and read-only memory (ROM) 12, each of which is coupled to a bus 18. Also coupled to the bus 18 are a mass storage device 13, a modem/adaptor 14, a display device 15, a keyboard 16, and a pointing device 17.

ROM 12 may be any conventional non-volatile storage device. Alternatively, ROM 12 may be, or may include, a programmable non-volatile storage device, such as flash memory or electrically erasable programmable read-only memory (EEPROM). Mass storage device 13 may be any conventional non-volatile device suitable for storing large volumes of data, such as a magnetic or optical disk or tape. Modem/adaptor 14 may be a standard telephone modem, a cable television modem, an Integrated Services Digital Network (ISDN) adapter, or any other suitable data communication device. Display device 15 may be any conventional visual display device, such as a Cathode Ray Tube (CRT) or a Liquid Crystal Display (LCD). Pointing device 17 may be any conventional device for moving a displayed pointer or cursor on a display device, such as a mouse, trackball, stylus with light pen, or the like. Bus 18 may represent multiple buses, which may be interconnected by various adapters and/or controllers.

In one embodiment, the present invention is carried out in the client 1 by the CPU 10 executing sequences of instructions that are contained in a memory. More specifically, execution of the sequences of instructions contained in the memory causes the CPU 10 to perform steps according to the present invention which will be described below. For example, instructions may be loaded into RAM 11 from a persistent store, such as mass storage device 13, ROM 12, and/or from one or more other computer systems (collectively referred to as a "host computer system") over a network. For example, one or more of the servers 2 illustrated in Figure 1 may function as such a host computer system. The host computer system may transmit a sequence of instructions to a target computer

-7-

search criteria. A representation of the Web documents in the search results is then generated and displayed in the form of a visual map of the search results, an example of which is illustrated in Figure 3.

Figure 3 illustrates a display 20 which is rendered on the display device 15 of the client system 1. The display 20 shows a map of a portion of the Web according to one embodiment of the present invention. The map includes a number of displayed objects, such as objects A1, B1, C1, D1 and E1, each of which represents a Web document found in a search of the Web. The objects may be simple shapes, such as rectangles, squares, circles, etc., or they may be more complex objects, such as bitmaps, icons, and other more complex images. In one embodiment, each object includes a label indicating the title, subject, or keywords of the Web document it represents.

The location of each object on the display 20 indicates the degree of relevance of the corresponding Web document to the user's search criteria. For example, in the embodiment shown in Figure 4, the objects are organized into five rows, rows A, B, C, D and E. Objects in row A, which is aligned closest with the user's point of view (i.e., closest with a centered vertical axis of the display), represent Web documents that are most relevant to the user's specified search criteria, whereas objects in rows aligned farthest from the user's point of view, such as rows D and E, represent Web documents that are least relevant to the user's search criteria. In addition, objects which appear to be closer to the user (i.e., larger and closer to the bottom of the display 20) are more relevant to the user's search criteria than objects that appear to be farther from the user (i.e., smaller and closer to the vanishing point 30). Thus, objects A1, B1, C1, D1 and E1, represent Web documents that are more relevant to the search criteria than the documents represented by objects B4, C6 or E3. Object B1 represents a document that is more relevant than the document represented by object E1, and object A1 represents the document determined that is most relevant.

The display 20 also includes a pointer 21, the location of which is controlled by the user using the pointing device 17. The pointer 21 is used to select objects and initiate various functions, as will be described below. The display 20 also includes a menu bar 22, by which the user can access various functions provided by the Web browser using the pointer 21 to activate soft buttons or pull-down menu items.

specificity: "history", "explorers", "North America", "Spaniards", and "Ponce de Leon". It is advantageous to use a variety of different levels of specificity in order to increase the likelihood of retrieving relevant documents. For example, if the term "Ponce de Leon" were used as the only search criterion, then the search might retrieve irrelevant documents, such as one describing a restaurant named Ponce de Leon. Conversely, if only "history" and "North America" were used as search criteria, the search might yield an undesirable number of Web documents which do not relate to Ponce de Leon.

Assume now that the search has been completed. Referring again to Figure 3, in one embodiment objects representing documents that have a strong correspondence to all of the criteria (history, explorers, North America, Spaniards, and Ponce de Leon) are assigned to row A. For objects within row A, the position of the object within row A depends upon its degree of correspondence only to the most specific criterion, Ponce de Leon. Objects representing Web documents are assigned to the outer rows D and E when they have a strong correspondence to only to the more general criteria, such as history, with little or no correspondence to the more specific criteria. In an alternative embodiment, objects might be organized within row A according to the corresponding Web documents' overall degree of correspondence to all five criteria. An overall degree of correspondence might be computed, for example, as a weighted average of the number of hits on each particular search term within each document, where weights is assigned based on the specificity of the search terms. Also, in an alternative embodiment, the outer rows might be reserved for objects representing Web documents having a low overall degree of relevance to all criteria.

The present invention also includes a technique for visually representing hypertext links between Web documents. Referring now to Figure 4, an embodiment is illustrated in which the display 20 includes arrows connecting objects to represent hypertext links. It will be recognized that hypertext links can be represented within the scope of the present invention in ways other than by using arrows. In Figure 4, arrows 32, 33, and 34 connect object B4 with objects D1, A2, and E3, respectively. The arrows 32, 33, and 34 indicate that the Web documents represented by objects D1, A2, and E3 can be viewed by selecting hypertext anchors located in the document represented by object B4. The arrowhead on each of the arrows 32, 33 and 34 represents the logical "direction"

-11-

selected object can be carried over to the secondary display or it can be adjusted in some other manner. Hypertext links between the Intel home page and the documents represented by objects F1 through F5 are represented by arrows 41 through 45, respectively.

In one embodiment, Web documents referenced by the selected Web document are represented in the secondary display 40 only if they appeared in the map of display 20 (Figure 3). In another embodiment, however, all documents linked to the selected Web document are represented in the secondary display 40, even if they were not included in the search results; this (second) embodiment might be implemented, for example, if the selected document has already been downloaded to the client 1, such that its hypertext links are known to the client 1.

Figure 6 illustrates a configuration of software components use to implement the present invention. A search agent 51 receives search criteria input by a user. The search agent 51 prompts the user to specify the search criteria in a particular manner or form, i.e., as several terms with varying degrees of specificity. The search agent 51 then generates a search request that is compatible with a conventional search engine 53 and provides the request to the search engine 53. In response, the search engine 53 searches the Web and return the results to the search agent 51.

The search agent 51 then examines the content of the search results, reorganizes, and, if necessary, filters the search results. This examination may include, for example, examining the context of keywords from the search criteria, such as whether keywords appear in the title of the Web page as opposed to in the body of the Web page. This process may also include performing secondary searches of the initial search results. Such a secondary search might include the combining of certain search terms (e.g., "the explorer Ponce de Leon"), for example. The ranked search results are then provided by the search agent 51 to a layout generator 52.

The layout generator 52 generates an object for each document in the ranked results and determines the appropriate position and other display attributes (i.e., size, color, texture, etc.) of the objects. The layout generator sends display data including this layout information to the display device 15, which causes the display device 15 to display a map of Web sites, such as that shown in Figures 3

-13-

search results (minus any documents that were eliminated) are then ranked (reorganized) in step 706 to reflect their degree of relevance to the user's search criteria. In step 707 the layout generator 52 generates display data to cause the 3-D map to be displayed to the user, such that the position of each object representing a Web document reflects the relevance of the document to the user's criteria.

Figure 8 illustrates the step 707 of generating a 3-D map in greater detail, according to one embodiment. In step 801, for a given search criterion, the objects are assigned spatial positions on the display from front to back based on the number of hits for that criterion in each corresponding Web document. That is, the assignment of position in this step is based on the number of matches in each particular Web document to a particular search term. Referring again to the Ponce de Leon example, step 801 may involve locating all objects into row A (see Figure 3) which represent Web documents that include the most specific term, "Ponce de Leon". The Web document having the greatest number of occurrences of the term, "Ponce de Leon", is represented as object A1, whereas the Web document having the fewest number of occurrences (greater than 0) of that term is represented as the object in row A that is closest to the vanishing point 30. Step 801 is then repeated (per step 802) until each search criterion has been processed, such that the objects are organized into a number of sets (e.g., rows). For example, step 801 is repeated for the search criteria "history", "explorers", "North America", and "Spaniards".

In step 803, each resulting set of Web documents is then assigned a position on the screen which reflects the overall degree of relevance of that entire set to the user's objective. In particular, rows which are sorted according to the most specific search criteria are aligned most closely with the user's point of view, while rows that are sorted according to more general criteria are aligned toward the peripheral of the user's point of view (i.e., towards the perimeter of the display). For example, the most-centered row in Figure 3, row A, is sorted according to the most specific search criterion, "Ponce de Leon", while the outermost rows D and E are sorted according to the more general criteria, "history" and "explorers".

Various attributes of the displayed objects and attributes of connections between objects can be used to further indicate relevance and other information relating to Web sites. For example, connections (e.g., arrows) representing hypertext links can be color-coded to indicate the degree of relevance of Web

-15-

preceding or following a hypertext anchor might be taken as a descriptor to label the corresponding arrow. Alternatively, an image close to a hypertext anchor or the hypertext anchor itself might be used as a descriptor.

Thus, a method and apparatus for graphically representing a portion of the World Wide Web have been described. Although the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention as set forth in the claims. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

-17-

6. A computer-implemented method according to claim 4, wherein the plurality of sets of data comprises a plurality of World Wide Web pages, such that each of the objects represents one of the World Wide Web pages.

7. A computer-implemented method according to claim 6, wherein the plurality of World Wide Web pages are referenced by a plurality of links, wherein the step of causing the map to be displayed comprises the step of causing the links to be represented on the display device as connections between objects.

8. A computer-implemented method according to claim 6, wherein the method is performed in conjunction with executing a program for browsing the World Wide Web.

9. A computer-implemented method according to claim 4, wherein the step of generating the map of the sets of data comprises the step of generating a map having a three-dimensional appearance, such that the ranking of the data sets is indicated by the apparent relative positioning of the objects in three dimensions.

10. A method of enabling a target computer to represent a plurality of sets of data, the sets of data distributed among a plurality of computers connected on a network, the method comprising the step of transmitting sequences of instructions from a host computer to a target computer, the sequences of instructions including instructions which, when executed on the target computer, cause the target computer to perform the method recited in claim 1.

11. In a computer system including a processor and a display device, a method of representing a portion of the World Wide Web, the method comprising the steps of:

identifying a plurality of World Wide Web pages having a correspondence to a set of predefined criteria;

obtaining a ranking of the plurality of World Wide Web pages based on a set of predefined criteria;

generating a map of the plurality of World Wide Web pages based on the ranking; and

-19-

20. A method according to claim 18, wherein the parameter is one from the list consisting of:

- a number of requests for said one of the Web pages during a period of time;
- a number of hypertext links referenced by said one of the Web pages; and
- a number of words in said one of the Web pages.

21. A method according to claim 18, wherein the visual attribute is at least one from the list consisting of:

- a color the object corresponding to said one of the Web pages;
- a size of the object corresponding to said one of the Web pages;
- a shape of the object corresponding to said one of the Web pages;
- a texture of the object corresponding to said one of the Web pages; and
- a degree of focus of the object corresponding to said one of the Web pages.

22. A method according to claim 18, further comprising the step of receiving a user input for determining the visual attribute.

23. A method according to claim 16, wherein the indication of the ranking comprises at least one attribute of a given object from the list of attributes consisting of:

- a color the given object;
- a size of the given object;
- a shape the given object;
- a texture of the given object;
- a contrast of the given object;
- a brightness of the given object; and
- a degree of focus of the given object.

24. A method according to claim 16, wherein the plurality of World Wide Web pages are referenced by a plurality of hypertext links, wherein the step of causing the map to be displayed comprises the step of causing the hypertext links to be represented on the display device as connections between objects.

30. A method according to claim 29, wherein the plurality of World Wide Web documents are referenced by a plurality of links, and wherein the method steps further comprise the steps of:

retrieving a Web document specified by one of the links; and
causing the Web document specified by said one of the links to be displayed on the display device.

31. A method according to claim 29, wherein the plurality of World Wide Web documents are referenced by a plurality of links, and wherein the step of causing the map to be displayed comprises the step of causing the links to be represented on the display device as connections between objects.

32. A method of enabling a target computer to represent a portion of the World Wide Web, the method comprising the step of transmitting sequences of instructions from a host computer to a target computer, the sequences of instructions including instructions which, when executed on the target computer, cause the target computer to perform the method recited in claim 31.

33. A method according to claim 29, further comprising the step of representing a parameter associated with one of the World Wide Web documents using a visual attribute of an object corresponding to said one of the Web documents.

34. A method according to claim 33, wherein the parameter is a degree of relevance of said one of the Web documents to the set of predefined criteria.

35. A method according to claim 33, further comprising the step of receiving a user input associating the attribute with the parameter.

36. A method according to claim 33, wherein the visual attribute is at least one from the list consisting of:

a color the object corresponding to said one of the Web documents;
a size of the object corresponding to said one of the Web documents;
a shape of the object corresponding to said one of the Web documents;

-23-

41. A computer system according to claim 40, wherein each of the hypertext documents is one of the plurality of World Wide Web pages.

42. A computer system according to claim 40, wherein the method steps further comprise the steps of:

retrieving a Web page specified by one of the links; and
causing the Web page specified by said one of the links to be displayed on the display device.

43. A computer system according to claim 40, wherein the instructions are executed by the processor in conjunction with execution of instructions for generating a Web browser.

44. A computer system according to claim 40, wherein the instructions which cause the processor to generate a visual map comprise instructions which cause the processor to generate a plurality of objects for display on the display device, such that each of the World Wide Web pages is represented on the display device as one of the objects.

45. A computer system according to claim 40, wherein the visual indication of the ranking comprises an arrangement of the objects having a three-dimensional appearance, wherein the visual indication of the ranking comprises the apparent relative positioning of the objects in each of three dimensions.

46. A computer system according to claim 40, wherein the logical links between sets of data comprise a plurality of hypertext links corresponding to the World Wide Web pages, wherein the instructions for causing the map to be displayed comprises instructions for causing the hypertext links to be represented on the display device as connections between objects.

47. A computer system according to claim 40, wherein the instructions which cause the processor to generate a visual map further comprise instructions which

53. A machine-readable program storage medium according to claim 51, wherein the map is characterized by an arrangement of the objects, the arrangement having a three-dimensional appearance indicative of the ranking of the World Wide Web documents.
54. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a color of at least one object.
55. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a size of at least one object.
56. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a shape of at least one object.
57. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a texture of at least one object.
58. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a contrast of at least one object.
59. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a brightness of at least one object.
60. A machine-readable program storage medium according to claim 49, wherein the indication of the ranking comprises a degree of focus of at least one object.
61. A machine-readable program storage medium according to claim 51, wherein the plurality of World Wide Web documents are referenced by a plurality of hypertext links, wherein the step of causing the map to be displayed comprises the step of causing the links to be represented on the display device as connections between objects.

-27-

means for causing the map to be displayed on the display device such that the map visually indicates the ranking, wherein the map includes a plurality of objects displayed on the display device, each of the objects representing at least one of the hypertext-based documents which correspond to the set of user-specified criteria, wherein links between the hypertext-based documents are represented as connections between the objects.

67. An apparatus according to claim 66, wherein the means for causing the map to be displayed comprises means for causing the map to be displayed as a three-dimensional map, wherein the arrangement of the objects within the three-dimensional map indicates degrees of correspondence of the hypertext-based documents to the user-specified criteria.

68. An apparatus according to claim 67, the apparatus further comprising means for generating a Web browser.

69. A computer-implemented method of representing a plurality of hypertext-based documents, the documents distributed among a plurality of computers on a network, the method comprising the steps of:

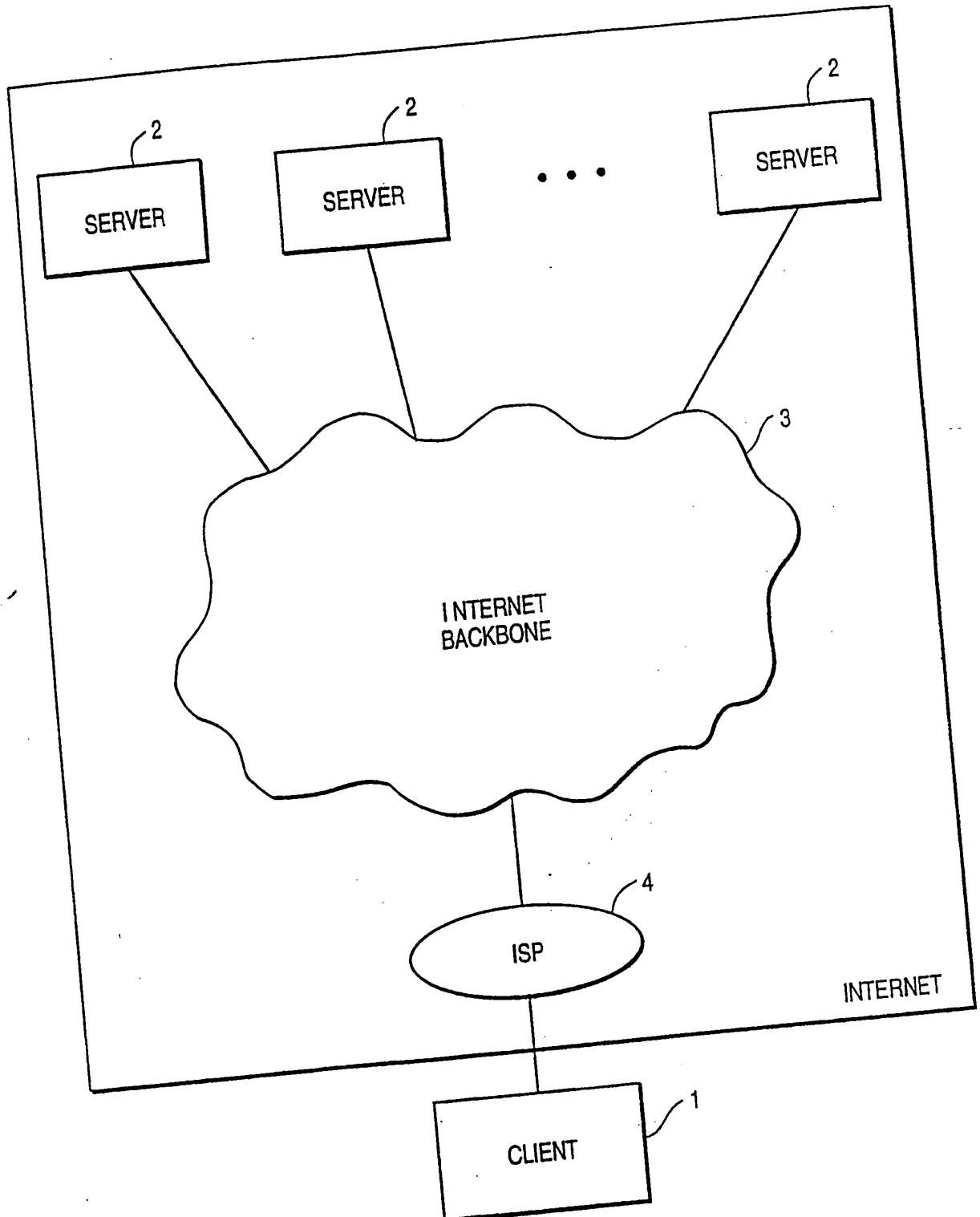
causing a plurality of objects to be displayed on a display device, each of the objects representing one of the hypertext-based documents; and

representing a parameter associated with one of the hypertext-based documents using a visual attribute of an object corresponding to said one of the hypertext-based documents.

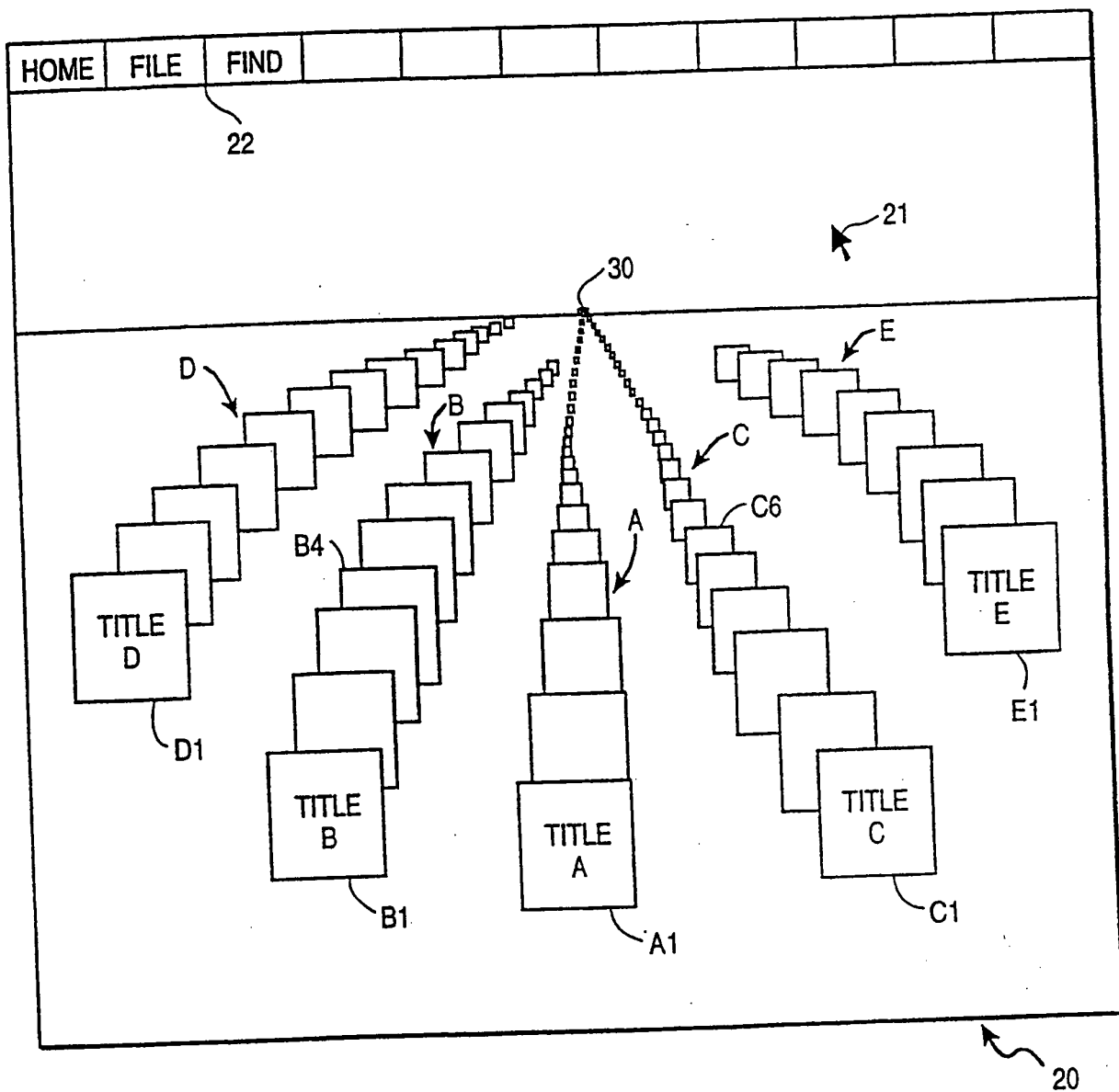
70. A method according to claim 69, wherein each of the hypertext-based documents corresponds to a World Wide Web document.

71. A method according to claim 70, further comprising the step of receiving a user input for specifying the attribute.

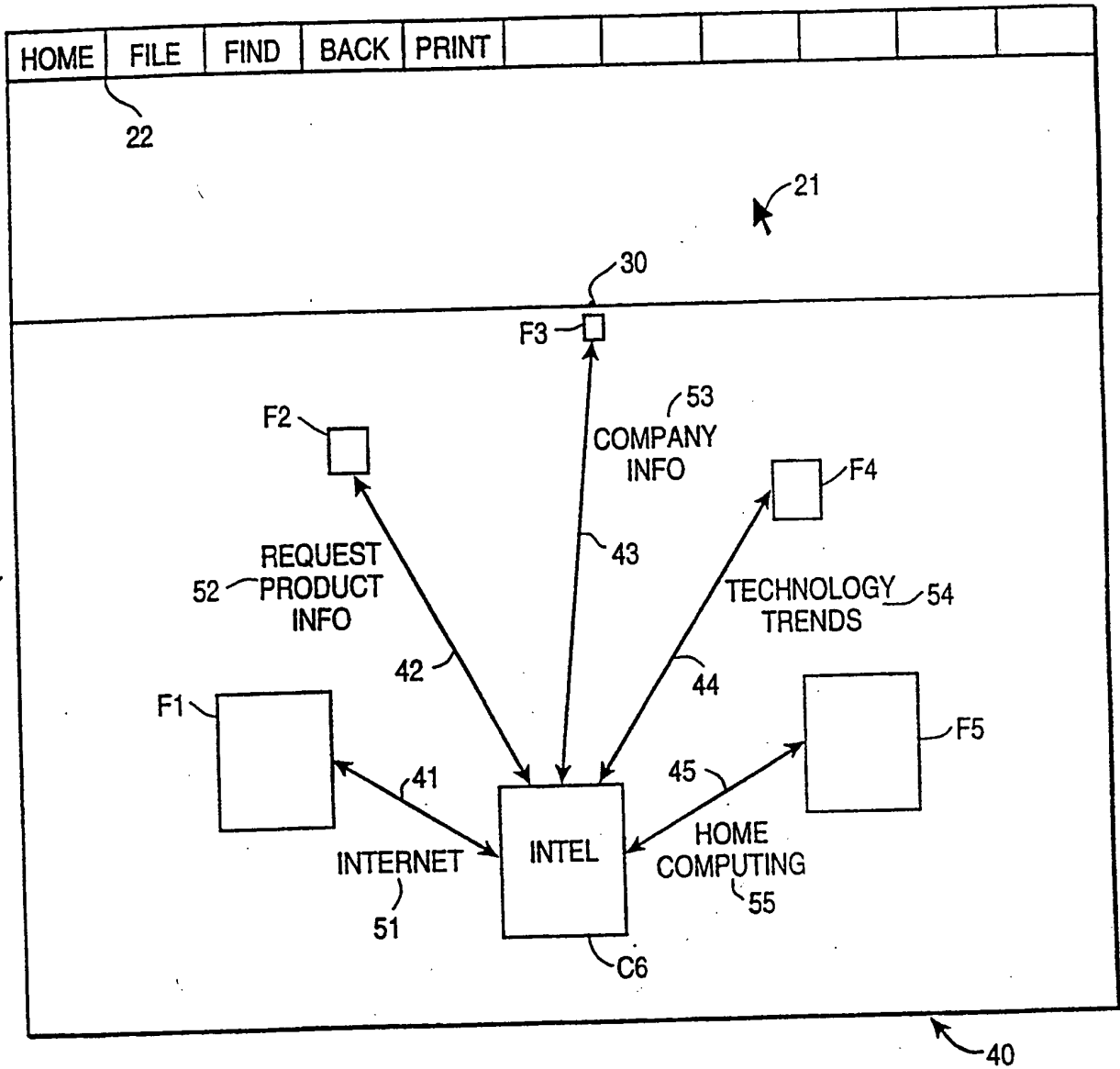
72. A method according to claim 70, further comprising the step of receiving a user input for specifying the parameter.



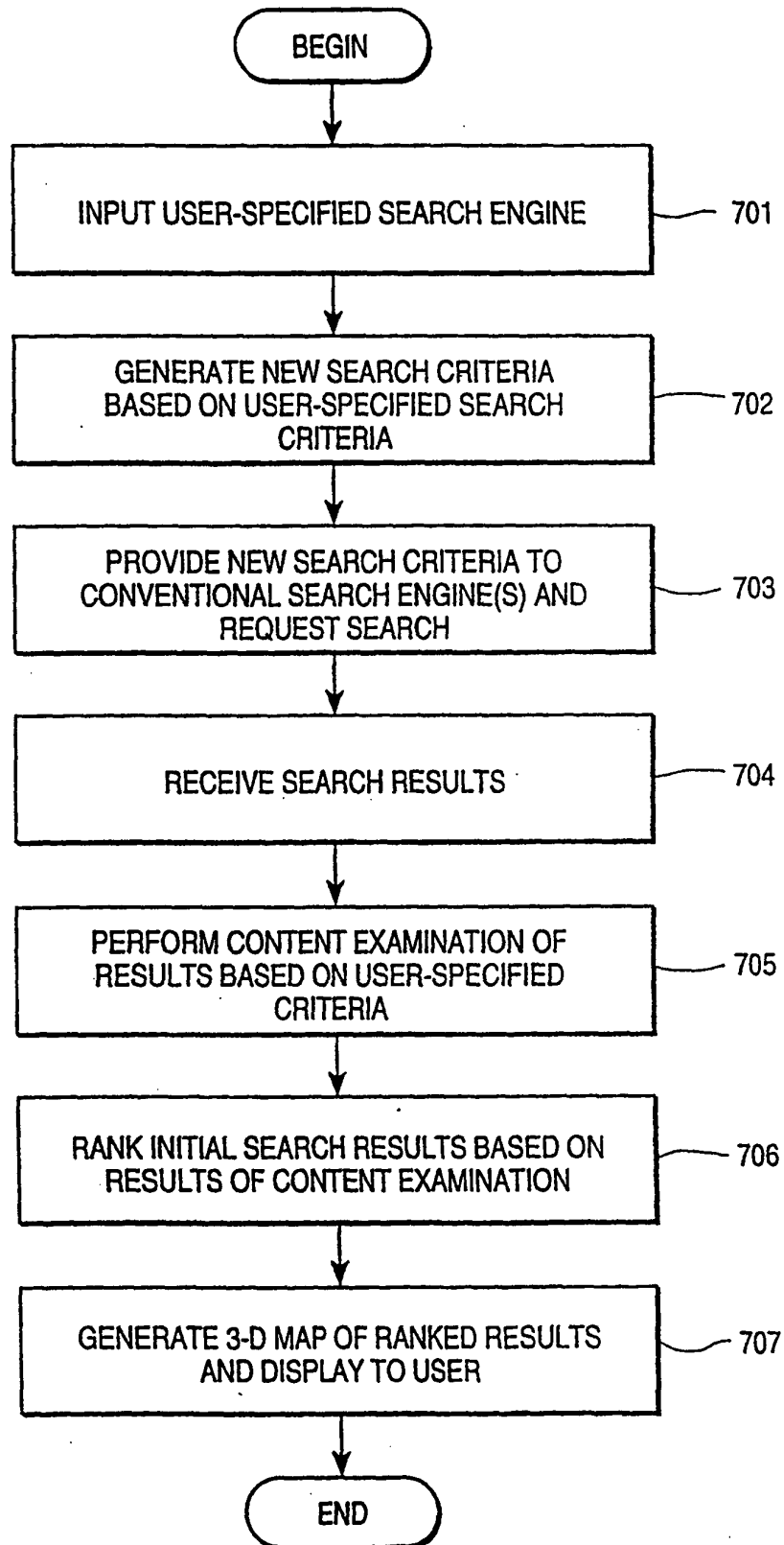
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7/8



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A technique is provided for displaying a map of a portion of the World Wide Web. A number of Web documents are retrieved by a client computer system executing a search engine. Web documents are then represented on a display device as objects (A1, B1, C1 and D1) and the relevance of a Web document to the search criteria is indicated by the apparent distance of the corresponding object to the user, e.g., more relevant objects appear larger and closer to the bottom of a display (20). Hypertext links between Web documents are represented as arrows (32, 33, 34) between the objects. Additional information relating to Web sites, such as the popularity of a Web site, the length of

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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US CL : 707/102

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 707/102

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
APS, Dialog

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 5,544,352 A (EGGER) 06 August 1996, figures 4A, 5B-5H, col. 5 lines 5-14, col. 27 lines 1-4.	1-6,8,10-19 ----- 7,9,20-76
Y,P	US 5,671,381 A (STRASNICK et al.) 23 September 1997, col. 5 line 58 - col. 6 line 9, col. 4 lines 27-33, fig. 1, col. 14 lines 15-67, col. 4 lines 18-22, col. 6 lines 4-6.	7,9,20-24,29-76
Y	Andrews, Pichler, and Wolf, "Towards rich information landscapes for visualizing structured web spaces," IEEE Comput. Soc. Press, 28 October 1996, p. 62 col. 2, p. 63 fig. 1.	7,9,20-21, 23-76

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

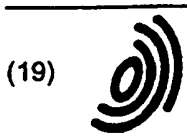
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O document referring to an oral disclosure, use, exhibition or other means		
P document published prior to the international filing date but later than the priority date claimed		

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(54) Facility for selecting and printing web pages

(57) A program of instructions executing on a network client computer provides a facility for printing network-accessed documents such as Web pages. The facility allows a user to tag documents obtained from a network for subsequent printing. A reference for each tagged document is assembled into a set of tag references. A representation for each tag reference, such as a thumbnail replica of the referenced document, may be displayed and the set may be edited to remove or reorder selected tag references. A single user request causes the facility to print a rendition of the documents that are referred to by tag references in the set. The rendition may be generated according to one or more user preferences. The facility can also provide features that allow a user to easily tag all Web pages accessible from the home page of a Web server and to print a collection of Web pages or documents that constitute an on-line book. The latest version of each document that is available from the network is used to print the on-line book.

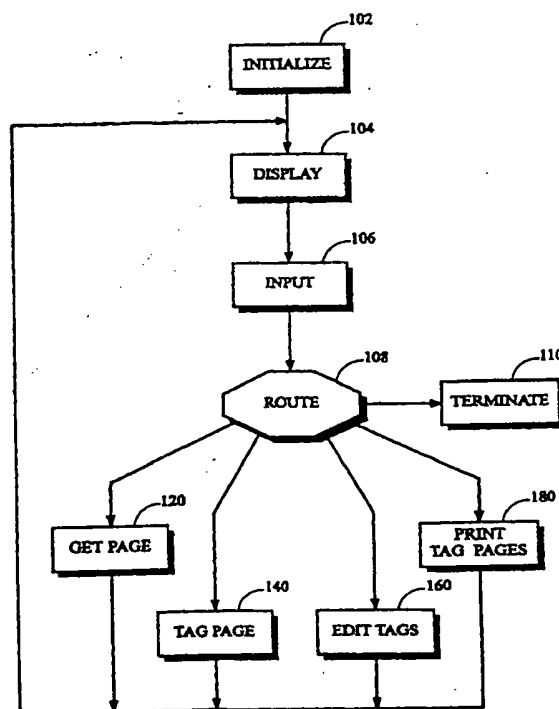


Fig. 3

puter that may be used as a network client or network server to implement various aspects of the present invention.

Fig. 3 is a high-level flow diagram of one process that may be used to carry out various aspects of the present invention.

Figs. 4 through 7 are more detailed flow diagrams illustrating ways in which some of the steps in the process of Fig. 3 may be carried out.

Fig. 8 is a flow diagram illustrating one way in which a "tag-all" command may be carried out.

Fig. 9 is a schematic diagram of documents that reference one another.

Fig. 10 is a flow diagram illustrating one way in which an "online book" may be printed.

MODES FOR CARRYING OUT THE INVENTION

Overview

[0012] Fig. 1 is a schematic representation of a network in which network client 10 uses network 40 to access resources provided by network servers 30 and 35. Although it is contemplated that network server 30 and network server 35 are hypermedia servers, perhaps operating in conformity with the Hypertext Transfer Protocol (HTTP), this is not necessary to practice the present invention. The nature of the communication paths connecting network client 10, network server 30 and network server 35 to network 40 are not critical to the practice of the present invention. Such paths may be implemented as switched and/or non-switched paths using private and/or public facilities. Similarly, the topology of network 40 is not critical and may be implemented in a variety of ways including hierarchical and peer-to-peer networks. Network client 10 and network server 30, for example, may be locally located with respect to one another and may be implemented on the same hardware.

[0013] Fig. 2 is a functional block diagram of a typical computer system that may be used to implement network client 10, network server 30 or network server 35. As shown, this computer system includes bus 11 that interconnects central processing unit (CPU) 12, system memory 13 and several device interfaces. Bus 11 can be implemented by more than one physical bus such as a system bus and a processor local bus. CPU 12 represents processing circuitry such as a microprocessor. System memory 13 represents various memory components such as random access memory (RAM) and read only memory (ROM). Input control 15 represents interface circuitry that connects to one or more input devices 25 such as a keyboard, mouse, trackball or stylus. Display control 16 represents interface circuitry that connects to one or more display devices 26 such as a video display terminal. I/O control 17 represents interface circuitry that connects to one or more I/O devices 27 such as a modem or a network connection. Storage control

18 represents interface circuitry that connects to one or more storage devices 28 such as a magnetic disk drive, magnetic tape drive, optical disk drive or solid-state storage device. Printer control 19 represents interface circuitry that connects to one or more printer devices 29 such as a laser printer, ink-jet printer or plotter. No particular type of computer system is critical to practice the present invention. For example, a computer with a bus architecture such as that illustrated in Fig. 2 is not essential.

[0014] In a typical embodiment, computer system 10 carries out various aspects of the present invention by using CPU 12 to execute a program of instructions that is fetched from storage device 28 or obtained from a network server or other source through I/O device 27. Requests for specific documents are received from a user through input device 25 and the document is obtained from a server on network 40 through I/O device 27. After it has been retrieved from network 40, the document is written into memory 13 and a rendition of the document is presented to the user through display device 26. In addition, the document may be written into a cache or local storage provided by storage device 28. In response to requests received from the user through input device 25, computer system 10 identifies selected documents and produces a rendition of the selected documents through printer device 29.

[0015] Various aspects of the present invention may be embodied in one or more programs of instructions executable by a machine and conveyed by a medium that is readable by a machine, including various magnetic media such as disk or tape, various optical media such as compact discs, and optical, infrared and radio-frequency communication channels.

High-Level Flow Diagram

[0016] Fig. 3 shows a high-level flow diagram of one process that may be used to carry out various aspects of the present invention. Initialize 102 represents steps taken to begin the process. This includes activities such as allocating memory, opening files, obtaining user configuration parameters and providing initial values for program variables. Display 104 represents steps taken to generate a visual or aural display to a user. This display includes a presentation of a user-to-program interface, informative messages or a rendition of a document. Input 106 receives requests from a user that are provided through an input device like a keyboard, mouse or other pointing device.

[0017] In response to each user request, route 108 invokes one or more processes that are selected according to the nature of the request. For example, in response to a request for a specific document, route 108 invokes a process represented by get-page 120 to obtain the document and present it to the user. In response to a request to select or "tag" a document for subsequent printing, route 108 invokes a process repr -

Print Tagged Pages

[0026] Fig. 7 illustrates one way in which print-tag pages 180 may be carried out. In step 181, the process determines whether the set of tagged documents is empty. If the set is empty or, alternatively, program variables have not yet been initialized to represent the set, an indication of this condition is generated in step 182 and the process continues with display 104 presenting the error indication. If the set is not empty, step 183, if necessary, fetches into memory 13 the document that corresponds to the first tag reference in the set. In a preferred embodiment, a fetch is not performed if the document is already stored in memory 13. In yet another embodiment, a document is automatically obtained from network 40 if it is not available from local storage such as storage device 28.

[0027] Step 184 analyzes the contents of the document and generates "image information" that represents an image or rendition of the document. The form of the image information is dictated by system requirements. In some systems the image information is device dependent, which means the form and content of the image information depends on the choice of printer device 29. In other systems, the image information is device independent but must conform to standards or specifications imposed by the operating system. Step 184 also causes computer system 10 to send the image information to printer device 29 so that the rendition can be printed. Step 185 reiterates steps 183 and 184 until all of the documents represented by tag references in the set have been processed. The process then continues with display 104.

[0028] An embodiment of the print process may be also carried out for one or more subsets of tagged documents. Such an embodiment operates in the same manner as that just described except that references to "set" should be understood to refer to the appropriate subsets.

[0029] In preferred embodiments, the user is allowed to specify one or more preferences that control various aspects of how the image information is generated. For example, an embodiment could allow a user to indicate that certain formatting features such as colors, underlining, italicization, use of bold-faced fonts, and various types of graphical objects should be rendered or not rendered. As another example, an embodiment could allow a user to indicate whether documents should be rendered with "page breaks" inserted at positions controlled by the user or controlled by programs that analyze document content. Storage device 28 could be used to store the user preferences.

Additional Features

[0030] Processes for two additional features are illustrated in Figs. 8 and 10. Fig. 8 illustrates one way to carry out a "tag-all" request. Fig. 10 illustrates one way

in which an "online book" may be printed. These features are described below.

Tag-All Request

[0031] A "tag-all" request invokes a process to tag a designated document and to tag all other documents that are referenced directly and indirectly by that designated document. This process is somewhat similar to forming a set that includes a designated person in a hierarchical organization and all other persons in the organization that are subordinate to the designated person. It is anticipated that all Web pages for a particular Web site could be easily tagged by merely obtaining a "home page" for the site and then making a tag-all request.

[0032] The tag-all process illustrated in Fig. 8 is recursive, meaning that the process involves the use of a procedure or computer routine that invokes itself. The procedure or routine is processed to a step where self-invocation occurs until a condition for termination is met, at which time each instance of invocation completes processing in order from the last one invoked to the first one invoked.

[0033] Step 151 represents activities that are required to implement and initialize a recursive routine. For example, this may include allocating memory or manipulating a stack to save program variables from a previous invocation and initializing program variables for this particular instance of invocation. Step 152 determines whether the current document is already in a set. This set may be the same set discussed above in connection with tagging documents or it may be different. The following discussion and the process illustrated in Fig. 8 assume the sets are different.

[0034] If the current document is already in the set, the process continues with step 159. Step 159 represents activities that are required to terminate a recursive routine such as, for example, deallocating memory or manipulating a stack to restore program variables from a previous invocation. If the current document is not yet in the set, step 153 adds the current document to the set and step 154 parses the contents of the current document to extract any references or links to other documents. If step 155 determines that the current document has no links to other documents, the process continues with step 159. If the current document does have links to other documents, the process continues with step 156, which "gets" the first document referenced by the current document. The newly obtained document becomes the new current document for the recursive invocation of the process in step 157.

[0035] When the recursive invocation returns, the newly obtained document is no longer the current document. Instead, the document that was deemed to be the current document in step 151 is reinstated as the current document. Processing continues in step 158, which determines if all documents referenced by the current

obtained from the network. If the counterpart has been superseded, step 206 replaces the counterpart with the document just obtained from the network. Step 207 determines whether all references in the book set have been processed. If not, the process continues with step 202, which obtains the next reference in the book set and submits a "get" request to network 40 to obtain the current version for the document that corresponds to this next reference. This process reiterates until step 207 determines that all references in the book set have been processed, at which time step 208 generates image information for each document in the online-book set.

[0043] An online book set may also be organized into one or more subsets as described above for tagged documents. For such an embodiment, the online-book print process also may be carried out for one or more subsets of the book set. Such a process can operate in the manner described above except that references to "book set" should be understood to refer to the appropriate subsets.

[0044] The process used to provide the on-line book feature may be varied in a number of ways. For example, each document could be rendered and printed one-by-one just prior to step 207. As another example, the rendition of each document could be controlled by one or more user preferences as described above. As yet another example, the book set could include references that represent either or both types of "tag-all" requests discussed above. The use of tag-all references could reduce the amount of storage required to store the book set and it would allow the contents of the on-line book to vary according to changes in the way documents are linked together.

[0045] The processes illustrated in the various figures omit various steps that may be important in practical embodiments but are not important for understanding concepts of the present invention. For example, the process shown in Fig. 10 does not include steps to handle error conditions such as syntactical errors in the book set or situations where one or more documents referenced in the book set are not available. It should be apparent that the illustrated processes are not the only way the present invention may be carried out.

Claims

1. A method for processing documents comprising:

obtaining a plurality of documents from a network, receiving tag requests and, in response thereto, storing a plurality of tag references that constitute a set of references, each tag reference identifying a respective one of said plurality of documents, and receiving a print request and, in response thereto, generating image information representing a rendition of each document that has

a tag reference in the set.

2. A method according to claim 1 that further comprises receiving one or more edit requests and, in response thereto, displaying a representation of the tag references in the set, removing a tag reference from the set, or reordering the tag references in the set.
3. A method according to claim 1 wherein one or more of said plurality of documents is stored in cache memory and the image information is generated from at least one document that has been saved in cache memory.
4. A method according to claim 1 that comprises receiving a tag-all request and, in response thereto, ensuring the set includes tag references for all documents that are referenced by a selected document.
5. A method according to claim 1 wherein at least one of the plurality of documents has content that conforms to a Standard Generalized Markup Language.
6. A method according to claim 1 that further comprises displaying a representation of contents for one or more documents having a respective tag reference in the set.
7. A method according to claim 1 that further comprises obtaining one or more user preferences and generating the image information according to the user preferences.
8. A method according to claim 1 that further comprises:

receiving a start request prior to obtaining the plurality of documents and, in response thereto, interacting with a network server to initiate facilities to service any subsequent tag requests and to service a stop request, and receiving the stop request and, in response thereto, interacting with a network server to initiate facilities to service the print request.
9. A method for processing documents comprising:

obtaining a set of references, each reference identifying a respective document, recording in local storage a document obtained from a network that is represented by a reference in the set and is either not yet recorded in local storage or is recorded in local storage in a form that is superseded by the document obtained from the network, and

ences in the set.

25. A medium according to claim 23 wherein one or more of said plurality of documents is stored in cache memory and the image information is generated from at least one document that has been saved in cache memory.

26. A medium according to claim 23 where the set of references includes at least one extended reference that represents all other documents that are referenced by a selected document corresponding to the extended reference.

27. A medium according to claim 23 wherein the set includes one or more tag-all references that each refer to a specified document and all documents that are referenced by the specified document.

28. A medium according to claim 23 wherein the method further comprises obtaining one or more user preferences and generating the image information according to the user preferences.

29. An apparatus for processing documents comprising:

means for obtaining a plurality documents from a network,
means for receiving tag requests and, in response thereto, storing a plurality of tag references that constitute a set of references, each tag reference identifying a respective one of said plurality of documents, and
means for receiving a print request and, in response thereto, generating image information representing a rendition of each documents that has a tag reference in the set.

30. An apparatus according to claim 29 that further comprises means for receiving one or more edit requests and, in response thereto, displaying a representation of the tag references in the set, removing a tag reference from the set, or reordering the tag references in the set.

31. An apparatus according to claim 29 wherein one or more of said plurality of documents is stored in cache memory and the image information is generated from at least one document that has been saved in cache memory.

32. An apparatus according to claim 29 that comprises means for receiving a tag-all request and, in response thereto, ensuring the set includes tag references for all documents that are referenced by a selected document.

33. An apparatus according to claim 29 wherein at least one of the plurality of document has content that conforms to a Standard Generalized Markup Language.

34. An apparatus according to claim 29 that further comprises means for displaying a representation of contents for one or more documents having a respective tag reference in the set.

35. An apparatus according to claim 29 that further comprises means for obtaining one or more user preferences and generating the image information according to the user preferences.

36. An apparatus according to claim 29 that further comprises:

means for receiving a start request prior to obtaining the plurality of document and, in response thereto, interacting with a network server to initiate facilities to service any subsequent tag requests and to service a stop request, and
means for receiving the stop request and, in response thereto, interacting with a network server to initiate facilities to service the print request.

37. An apparatus for processing documents comprising:

means for obtaining a set of references, each reference identifying a respective document,
means for recording in local storage a document obtained from a network that is represented by a reference in the set and is either not yet recorded in local storage or is recorded in local storage in a form that is superceded by the document obtained from the network, and
means for generating image information representing a rendition of the documents that are represented by a reference in the set.

38. An apparatus according to claim 37 that further comprises means for receiving one or more edit requests and, in response thereto, displaying a representation of the references in the set, removing a reference from the set, or reordering the references in the set.

39. An apparatus according to claim 37 wherein one or more of said plurality of documents is stored in cache memory and the image information is generated from at least one document that has been saved in cache memory.

40. An apparatus according to claim 37 where the set

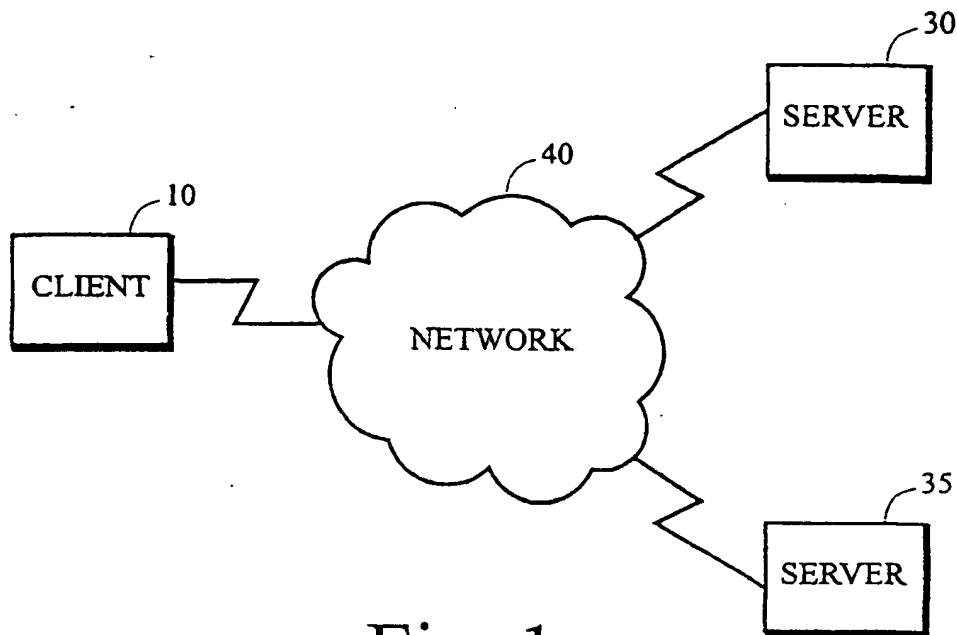


Fig. 1

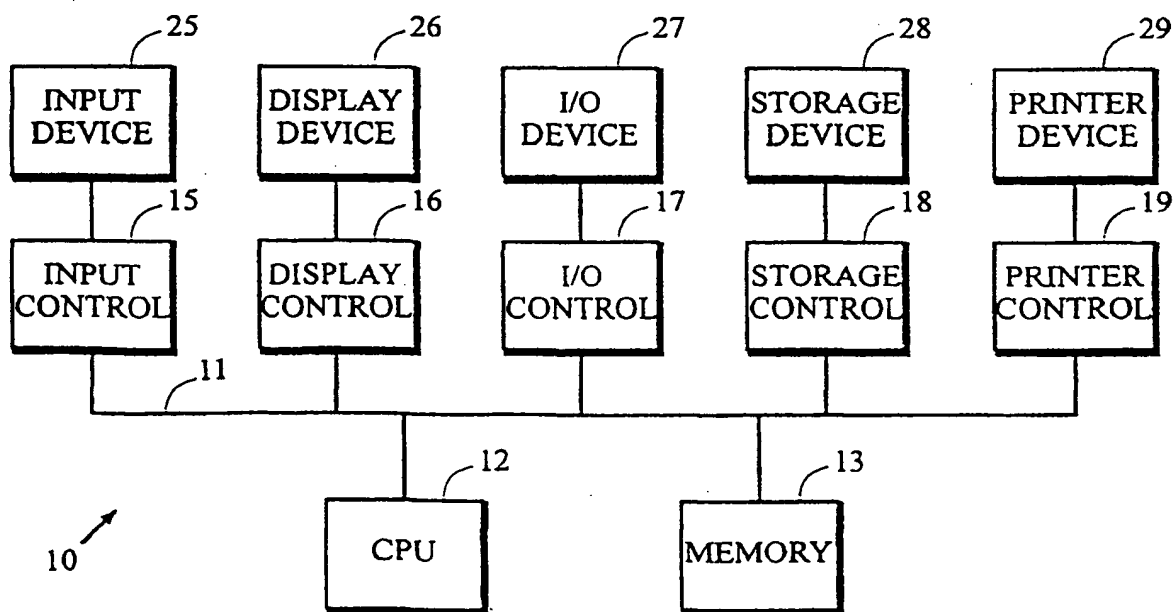


Fig. 2

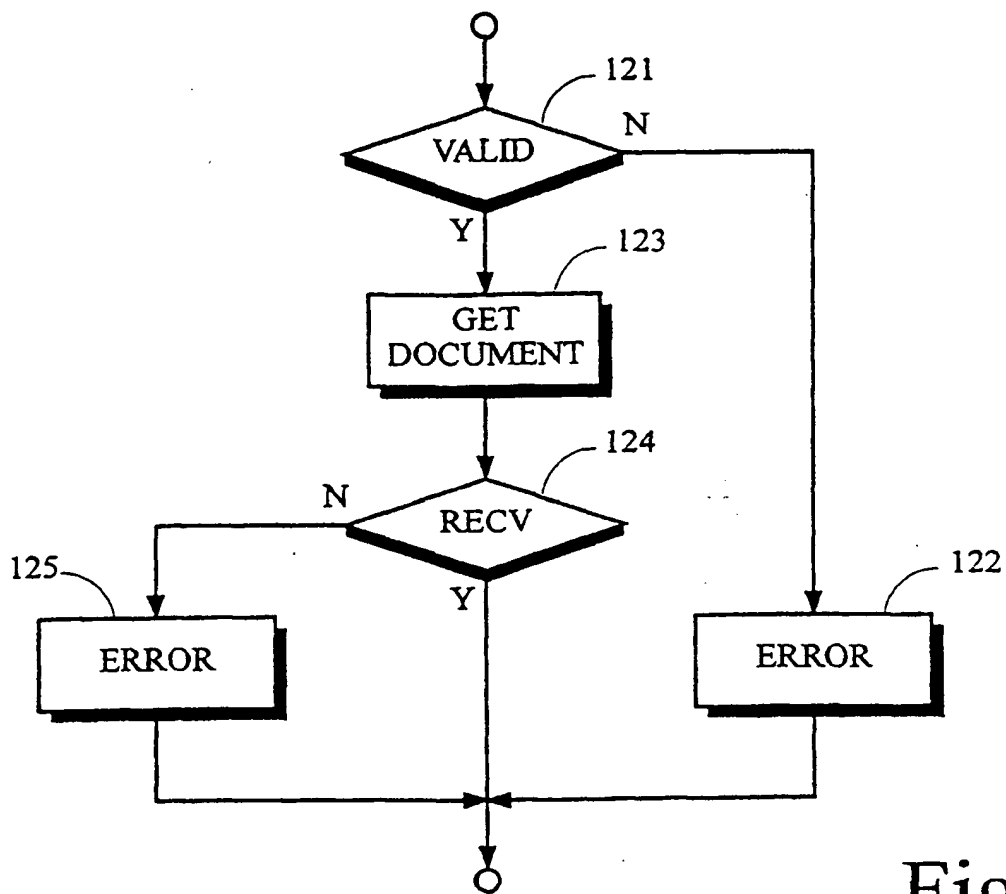


Fig. 4

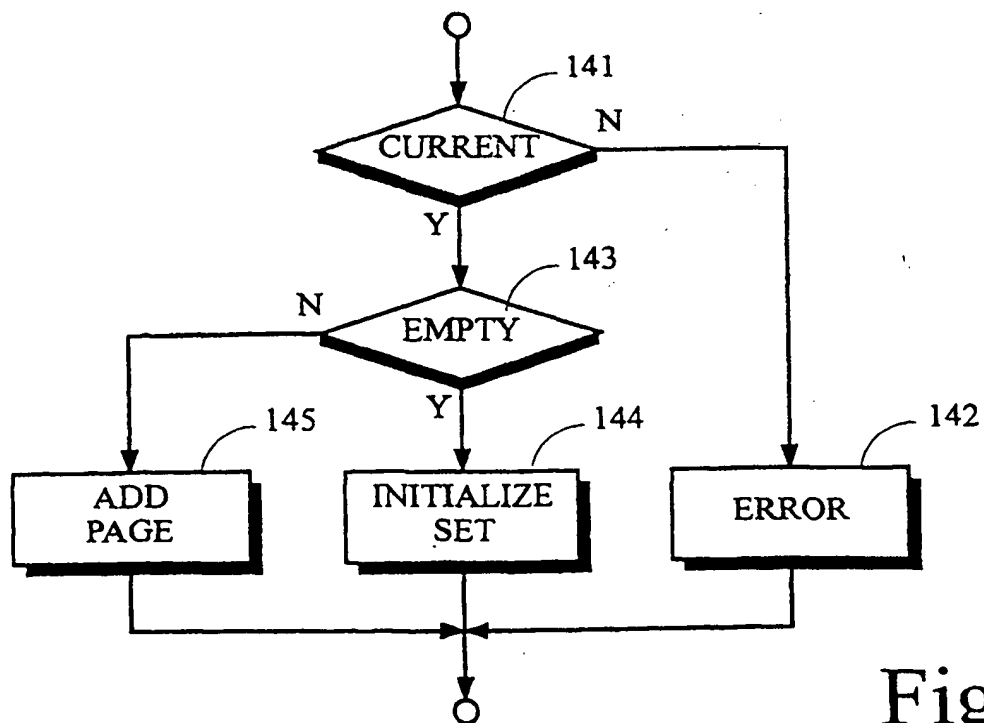


Fig. 5

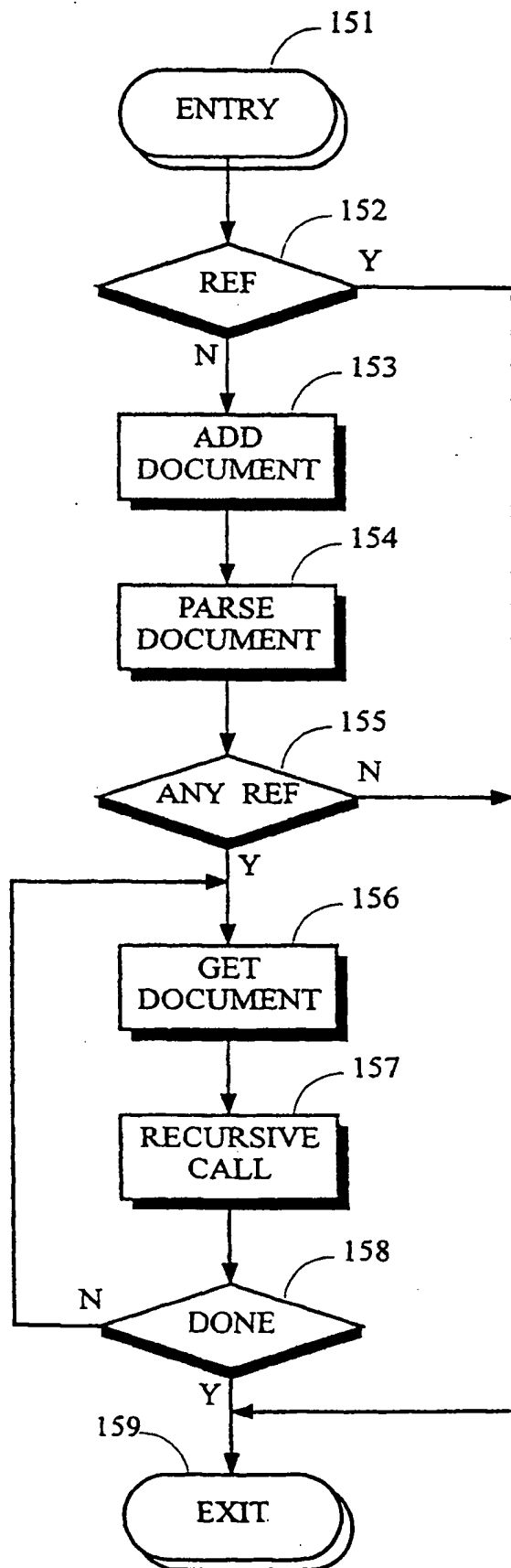


Fig. 8

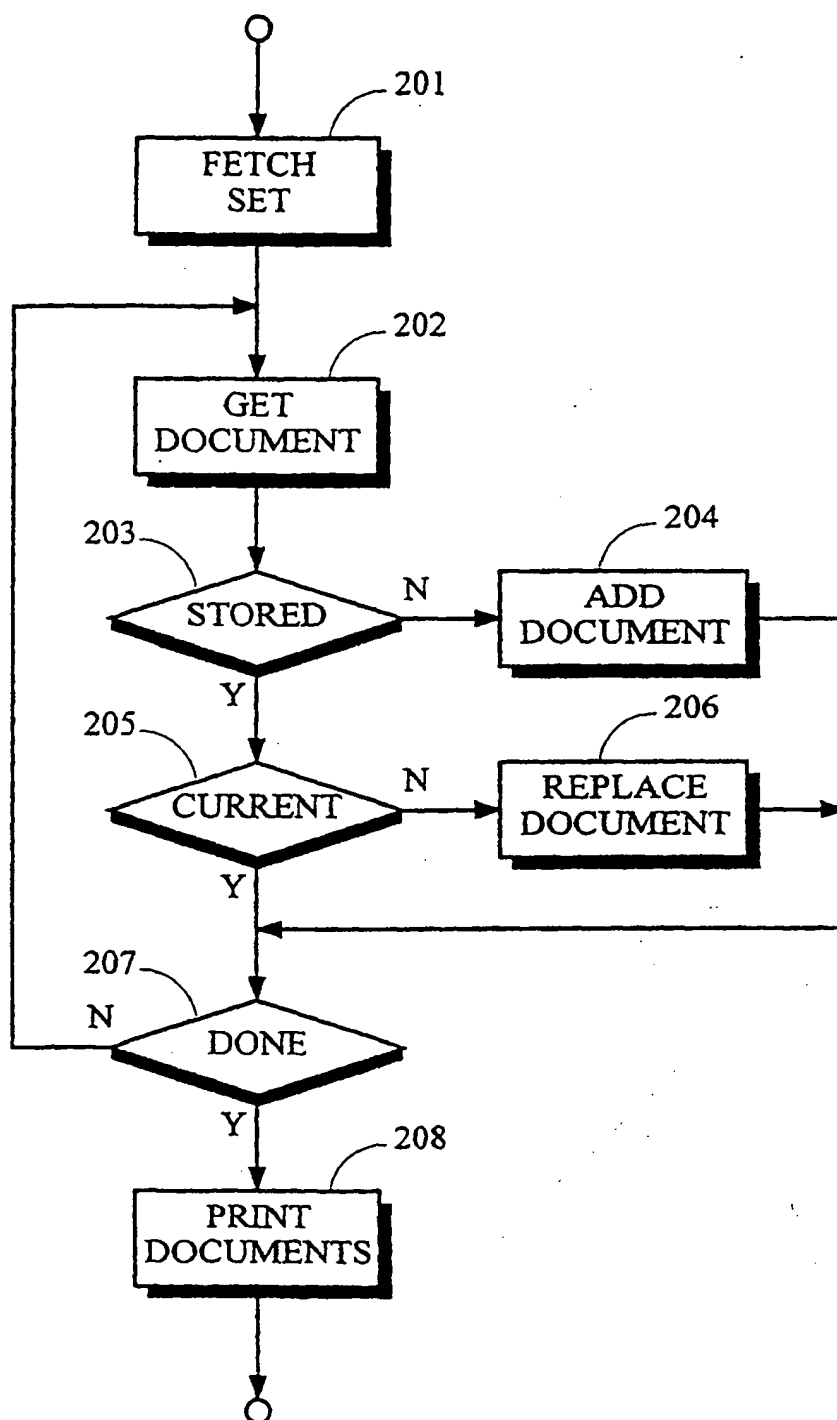


Fig. 10

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 11 3173

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-11-1999

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